are characterized by demonstrable histological changes." In the second place, Seguin shows that the histological lesions, apparently due to nervous disease, may be divided into two classes: "The first as above described being mere complications having a complex etiology, while those of the second class are really trophic lesions due to disease of the nervous system." Third: Without pretending to throw any new light on the intimate nature of real trophic lesions, Seguin points out that the disturbance occurs in continuous tissues, and finally ventures to suggest "that disease of the nervous system produces true trophic lesions when it interferes with the associated or inter-dependent life of continuous tissues."

From the physiological side a presentation was made by Dr. H. C. Wood. He opened with the proposition: "It is physiologically proven that the nervous system directly affects general nutrition." In support of this Wood appealed to the well-known facts of gland physiology. Next he discussed the evidence from the work of Gaskell and others, to show that there are anabolic and katabolic nerves controlling the heart. Finally, he brought forward the results of his own study on fever to show that the heat production, *i. e.*, tissue change, is controlled by a centre somewhere above the medulla. In speaking of the relations of the nerves to muscles, the motornerves are classed as katabolic, and the belief expressed that anabolic nerves, also, will in the future be found. Having presented evidence to show that the nervous system has the power of influencing nutrition, he passed to his second proposition "that various lesions are the immediate result of previous nerve disease, or nerve injury." Here Wood grouped all the cases considered by Seguin in his paper, but without any sub-division, and considered the evidence to prove the proposition just stated. His third point is that a distant lesion may follow a nerve injury or nerve disease without any precedent disturbance of the local circulation. This statement is supported entirely by evidence that decubitus may occur on the side where sensation only is paralyzed. The fourth proposition is the converse of the third. That "alterations in the condition of the vaso-motor centre are not capable of causing many of the distant lesions which follow injury or disease of the nervous system." This being mainly supported by observations on the ear of the rabbit.

In the discussion which followed, Dr. W. M. Ord of London described several cases of disease of the joints, which in his opinion were trophic.

Dr. H. P. Bowditch called attention to the nitrogenous and non-nitrogenous metabolism in muscle, and suggested that limitation of the term trophic to the former would simplify matters. Dr. David Ferrier touched on the question of a double nerve supply to muscle, and thought the study of the heat and other centres, might throw light on the question. Mr. Victor Horsley communicated the results of some work by Dr. Mott of London. Some nerves of the cauda in monkeys were tied and the femur on that side was found the seat of excessive (katabolic) changes. This is particularly interesting since loss of function and vaso-motor disturbances, both of which are often complicating factors, are in this case quite insignificant.

(There are two points in this matter which may be emphasized, namely, that the weight of opinion and anatomical results are against the view that trophic nerves form a separate class, and that the trophic action may be exerted along the nerve in a direction the reverse of that in which the impulses usually travel; witness all the forms of herpes associated with the posterior spinal roots.—REV.)

II.—HEREDITY AND SEX.

JULIUS NELSON, PH. D.

In this section I shall review certain representative modern discussions that bear upon the theory of heredity. We shall see that the

problems involved are very fundamental and of far-reaching significance for Psychology. Here is the ultimate basis to which students of Psychology as well as of Biology must refer their questions for ultimate solution; it is in fact impossible in this connection to separate the two sciences.

A large share of the discussion of the problems of heredity appertains to the various relations of sex. The importance of the latter subject, as indicated by the vast amount of literature of research and thought bearing upon related questions and the great variety of interests that center here, calls for its treatment in a special section to which the present article may be considered introductory.

The reviews will be presented in the following order. After stating the problem of heredity we consider theories of the constitution of protoplasm and of the importance of the cell nucleus to the problem. Then the subject of variation and the relation of the reproductive cells to the other tissues of the body are considered. This leads to the discussion of the origin of death. Then follows a brief reference to the principles of correlated variation, followed by a consideration of the psychic life of cells and the educability of protoplasm. The section concludes with a consideration of the seat of the soul, and metaphysical speculations on the relations of soul and body.

It is important to get a clear idea of the problem of heredity. Consider the following outline of the conditions of the problem. A complex living being is an organization of protoplasmic cells according to the principle of division of labor. All cells performing the same office in the body are nearly alike in appearance, and their aggregate is termed a tissue. Any cell in a tissue can produce its like by simple self-division into two equal parts. The cells of the reproductive tissues are each capable, when separated from their fellows, to build up by continuous multiplication, a new individual, which is a repetition more or less closely of the parent, both in structure and in all characteristics, including psychological ones. More wonderful yet, while this reproductive cell is building up the new individual a very orderly progress is followed, termed development, *(ontogeny)* which shows stages that map out successively the taxonomic character of the group in which the parent is included, beginning with class and ordinal characters, and leaving off with the specific; that is, *ontogeny is a condensed phylogeny.* That apparent divergence from this law may be accounted for by *cenogeny* or secondary adaptation only emphasizes the law, which in popular terms is that the development of the individual is a repetition of the history of its ancestors. Thus the resemblance of a child to its parent is a broad one, including the whole life history, and in this history all the ancestors reappear in a modified form.

But we must go deeper. The reproductive cell, while in its proper tissue, gave rise to cells like itself when division ensued, but in *ontogeny* the offspring, similarly produced, became differentiated into different tissues. For instance, the first division of the egg cell may give rise to the common ancestor of all the ectoderm cells and of the entoderm cells respectively; and subsequent divisions may be the separation of two great sets of organs derived from the ectoderm or entoderm. In fact, the cases are more complex and not thoroughly made out for any organism. However, when any cell has differentiated to assume its final function it has a limited character and apparently can never function in any other capacity, and apparently can not, or, at least, does not act as a reproductive cell. In some way, then, all the different tissues are represented in the egg.

But the modern zoölogist sees progress. Each individual of the line of ancestry transmitted to his offspring more than he received. In the battle with nature, organs became in some way modified and better

adapted for their purpose. Use strengthens organs, disuse enfeebles them, and even new organs, or at least differentiations of old ones, or a modification of their function may be acquired. Lamarck is the most famous advocate of the idea that such acquired characters tend to be transmitted. The idea is evidently prevalent that the children of one who has exercised his musical talent are furnished congenitally with increased musical abilities.

We must seek in the protoplasm of the egg (or *germ cell)* for structures that bear the impress of powers that represent the whole body. This is the modern form of the old doctrine of evolution which saw in the germ cell a complete miniature of the adult. But we must add that this structure of protoplasm can vary either spontaneously or in response to stimuli definitely or indefinitely.

Perigenesis der Plastidule. HÆCKEL.

Hæckel conceives protoplasm to be ultimately composed of molecular units that are themselves a complex system of vibrating atoms. Every new stimulus modifies and complicates the system. When a cell divides into equal parts the form of vibration of the molecules of the two cells is alike, but now the two cells are no longer acted on by similar forces and their systems become more and more divergently modified through life. Thus may we explain variation and phylogenetic differentiation. When cells divide into differentiated cells of the tissues in ontogeny, there is a splitting of the wave movements into two simpler systems. The increase of protoplasm by assimilation is the impressing upon the food molecules of an identical form of vibration. Finally, in sexual reproduction, which is simply the union of two germ cells from different parents, usually not too closely nor too distantly related, there is a union of systems that differ slightly, and hence a new combination, a new variety; so that in sexual reproduction the offspring never are the complete copies of their parents. It is evident that the weak point in this theory is that we have not the faintest idea how the wave motion is caused to split up in ontogeny according to so definite laws, nor, what is more important, how the conditions of the environment cause the proper variations to take place, that adapt the body to the environment. Then, too, we know that *the environment is of importance in ontogeny* for *not all* the characters of protoplasm are ever brought out in any case. The same person, if he could be brought back to repeat his life history under different circumstances, would appear as a very different individual in the final outcome. Life is full of "latent characters" waiting the proper stimulus to become active. Yet how does this action of the environment differ from the action which causes variation and new hereditary possession? Here is the field for inquiry.

Hæckel attempts to lay the foundations of Psychology by calling the persistence of these vibration-systems in their respective forms *memory*. Ontogenetic development is a rehearsing of the experience of protoplasm when it was in the ancestors, (for every child is but a portion of his parent, so that all protoplasm that is alive dates back to the foundation of the world). All that has been experienced has been retained in this cell memory.

Hæckel goes deeper than any other speculator upon these problems, and in some respects his theory has the merit of simplicity.

Abstammungslehre. NÄGELI.

Nägeli derides the Perigenesis theory and substitutes the "Idioplasm" theory. Not all protoplasm carries the hereditary powers, but that which does may be termed Idioplasm. This plasm is supposed to be distributed throughout the cell in the form of fibres that reach to the periphery of the cell; and whenever cells divide and remain united, the